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Air Force Research Laboratory • Materials & Manufacturing Directorate



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Cover composition by Mike Ro.

ManTech Highlights is an unofficial publication (cleared for public release) for the promotion of information relevant to, and about, the people and programs of the Manufacturing Technology Division of the Air Force Research Laboratory (AFRL) Materials and Manufacturing Directorate at Wright-Patterson AFB, Ohio.

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Viper[™] system returns huge savings on ManTech's investment

Wright-Patterson AFB, Ohio – The Manufacturing Technology (ManTech) Division of the Air Force Research Laboratory, working with Northrop Grumman, has successfully developed significant cost saving procedures in the manufacture and assembly of the Viper™ Mid-Infrared (IR) Laser. The Viper™ laser is one of the primary components in the Large Aircraft IR Countermeasures (LAIRCM) system, designed to protect C-17s, C-130s and other large aircraft from IR-guided surface-to-air missiles.

The LAIRCM will autonomously detect and signal the flight crew when the aircraft is threatened. It will track, and then jam the missile's guidance system, resulting in saved aircraft and aircrews. Test experts completed live-fire testing on the Large Aircraft Infrared Countermeasures system in July of 2002 in White Sands, N.M., putting the program on track to deliver the first laser-protected transport to Air Mobility Command by 2004.

Reduced acquisition and maintenance costs are expected to result in a net savings of \$4.2 million, doubling the return on the ManTech investment of \$2.1 million. Perhaps equally important is the dramatic increase in yield and reliability improvements, which are expected to result in enormous reductions in life cycle costs and increased system availability.

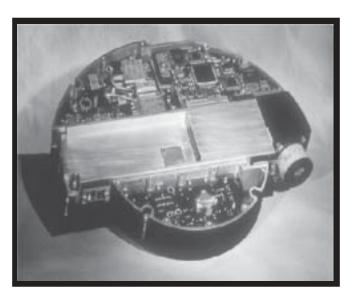
ManTech and Northrop Grumman representatives believed costs could be reduced for the Viper™ by addressing manufacturability, maintainability, reliability, supportability and availability issues. These cost reductions would, in turn, save money on the entire LAIRCM program.

One example of the steps taken to accomplish this was the insertion of Lean practices and principles to increase yield, reduce rework and touch labor costs. In general, design changes were made that reduced deficiencies and the number of assembly and adjustment steps for the electronic and optical components.

Another example was high value electronics, optics and other materials only being available from a single supplier. Multiple supplier sources were made available, creating more competition and driving the cost down, by substituting standardized components for the specialized ones.

Regardless of the steps taken that produced such significant savings, the baseline system performance of the Viper TM was not degraded in any way.

For more information on this program call the Technology Information Center at (937) 255-4689, and refer to item 02-510.



 $Viper^{TM}$ Laser module. (Photo courtesy of Northrop Grumman)

SAMPE honors ManTech's Abrams with Fellow nod

Wright-Patterson AFB, Ohio – The Society for the Advancement of Materials and Process Engineering (SAMPE) has elected Dr. Frances L. Abrams a "Fellow of the Society." Induction of new Fellows takes place during the annual International SAMPE Symposium and Exhibition each May in Long Beach, Calif.

Abrams, a senior engineer for the Manufacturing Technology (ManTech) Division of the Air Force Research Laboratory's (AFRL) Materials and Manufacturing Directorate, has long been considered one of the leading experts in the world in the processing of advanced composites.

"I was surprised, and extremely pleased when I learned of the honor," Abrams said. "If you work in advanced composites as I have, there can be no higher honor than this. It's truly gratifying," she concluded.

Her selection as a Fellow celebrates a long history of exemplary public service to her country through the application of her knowledge in composite processes that improve, sustain and cut the manufacturing costs of Air Force weapon systems. She is considered a role model for many of today's composite technology specialists.

A native of Oregon, Abrams received her bachelor of science in chemistry from Colorado State University in 1975, a second bachelor of science from the University of Dayton (UD) in Chemical Engineering in 1981, and completed her doctorate work in materials engineering from the UD in 1995. Abrams began her work at AFRL in 1979 under a co-op program for engineering students at UD. She accepted a full-time position as a materials engineer with the laboratory in 1980.

"Once I started here (AFRL), I never

wanted to work anywhere else," explained Abrams. "The people were friendly and helpful, the work was exciting and rewarding, and I found that, for a composites engineer, Wright Patterson is a crossroads for information about what's happening in the (composites) industry worldwide."

Regarded highly for her work in phenolic (a resin) processing, as well as advanced ablative (a protective coating) and carboncarbon propulsion materials and components, Abrams' contributions to composite processing are recognized throughout government and industry circles. She has served as a materials and process consultant to numerous Air Force and National Aeronautics and Space Administration systems solving real time issues.



(left) Frances Abrams, Composites Affordability Initiative (CAI) team member and senior engineer for the Manufacturing Technology (ManTech) Division, was recently elected a Society for the Advancement of Materials and Process Engineering (SAMPE) "Fellow of the Society."

She has planned for, performed research in, or managed many of the leading composite materials and processing initiatives over the past two decades. Currently, Abrams is the program manager for the Department of Defense and industry's Composites Affordability Initiative's Systems Engineering Team, providing leadership and technical expertise to the Air Force, Navy, and the U.S. airframe industry.

For more information on composites, call the Technology Information Center at (937) 255-4689 and refer to item 02-574.



ManTech embraces DoD transformation

The Department of Defense (DoD) Force Transformation Plan calls for a "more entrepreneurial, more creative approach" to acquiring the tools necessary to combat enemies abroad, and to protect the homeland through industrial preparedness. One Air Force Research Laboratory (AFRL) division is speeding its movement in that direction.

For nearly 50 years the Manufacturing Technology (ManTech) Division of AFRL's Materials and Manufacturing Directorate has been at the cutting edge of defense-related manufacturing technology as the key agency responsible for the management and execution of the Air Force Industrial Resources Programs. There have been many successful ManTech programs in the past, and the warfighter has benefited greatly from the work of ManTech engineers.

Regardless of past successes, there's a new set of complex global industrial base issues and increased competition from foreign markets over the past decade that have created a need for transformation by ManTech. This need includes increasing the flow of new technology to the warfighter by speeding it out of the laboratory, and shortening the product development and production lead times. ManTech transformation also relates to the content and focus of its programs and how the organization is internally structured for their execution.

The transformation need has been spurred by Air Force role and mission changes and heightened by consolidation and role changes within the defense industrial base. It has created a dramatic reduction in the number of military system contractors and at the same time has reduced the supporting supplier base. As the number of primary contractors has dwindled, their role has

shifted away from that of manufacturers and more toward that of system designers and integrators of purchased subsystems. In some cases they now compete with their suppliers.

ManTech is countering the adverse impacts of industrial base changes on the warfighter by adapting how it does business in order to make the most of reduced funding and the industrial resources at their disposal.

"Transformation is about changing the military culture into one that encourages innovation and intelligent risk taking. Transformation can mean using old things in new ways — a natural result of creative innovation."

Deputy Defense Secretary Paul D. Wolfowitz to members of the Senate Armed Services Committee in April 2002.

Their game plan for embracing transformation is spelled out in the recently completed, "ManTech 2015: A Strategic Planning Initiative." The initiative was undertaken to identify critical areas for ManTech investments in support of future Air Force industrial base needs, and to create initiatives, organization structures and external support that will address those areas.

Five Sector Teams, Aeronautical Systems, Armament and Directed Energy Systems, Space and Launch Systems, Sustainment, and Command and Control, Intelligence, Surveillance and Reconnaissance (C2ISR), are chartered to sustain the momentum through product/sector-focused follow-on planning that assures program relevance to priority sector requirements.

An overarching goal of the resulting ManTech plan is to improve production of small quantity buys that have the same cycle



The Air Force's newest multi-role fighter, the F-35 will be a major beneficiary of ManTech's successful transformation initiative. (U.S. Air Force Photo)

time, quality and price benefits of a large quantity buy.

So, the ManTech program of the near to mid-future will: 1) help the Air Force and its supporting industry cope with and evolve a more **agile acquisition** process; 2) undertake programs aimed at achieving full-spectrum **cycle time reduction** in order to deliver a copy to the warfighter in a more timely fashion; and 3) help assure the **affordability** of military essential manufactured products.

By targeting these three strategic objectives ManTech programs will address the basic nature of nearly all Air Force acquisition, which is small quantity buys.

The ManTech transformation strategy contains these four principal elements:

The new budgeting process will be driven by priority warfighter capability needs, supplemented by structured analyses of industry's ability to support those needs. This process will be tied closely to the Air Force Materiel Command budgeting process, with success measured by warfighter command advocacy for ManTech programs.

ManTech will invest in areas where commercial investment will not create the capabilities the Air Force needs. These areas usually relate to manufacturing capabilities that are unique to the production of mili-

tary products. The most obvious instances are manufacturing processes needed to produce systems that have no commercial counterparts, such as directed energy weapons.

ManTech will provide maximum impact on the defense industrial base.

The advances, capabilities, and business practices being developed by the commercial industries will be leveraged and adapted for military applications. Improving operational functions in the factory will reduce the cost, shorten the flow time, and improve the quality of processes and products.

This is already being accomplished in the Lean programs that have streamlined and improved much of the depot maintenance programs for the C-5 and F-15 inventory.

Future initiatives will focus on implementation and deployment from the beginning.

The ManTech program remains the only Air Force program specifically chartered to address generic issues of material, component, subsystem and full system production at acceptable cost. Yet, the ManTech program and organization can't transform the industrial base alone. It will take a joint effort from the DoD and industrial base. Story compiled by Gary Cunningham, AFRL/MLM



The Predator is already improved, thanks to a ManTech transformation program giving this unmanned aerial vehicle a laser targeting system. (U.S. Air Force Photo)

Title III program cuts cost, creates viable supplier base

Wright-Patterson AFB, Ohio – A Title III project with the Manufacturing Technology (ManTech) Division of the Air Force Research Laboratory's Materials and Manufacturing Directorate, under a cooperative agreement with the Titanium Matrix Composite Turbine Engine Component Consortium (TMCTECC), has established a viable supplier base and reduced the cost of manufacturing Titanium Matrix Composite (TMC) components for military and commercial applications.

This also marks the accomplishment of the first production implementation of a TMC component in aircraft gas turbine engines. A TMC Nozzle Compression Link is earmarked for use in the General Electric-built F110 engine for the F-16.

Modern aircraft performance is directly related to thrust-to-weight ratio of engines and the combined weight of the aircraft structure, systems, sub-systems and fuel. TMC is an advanced composite material of titanium reinforced with either silicon carbide particulate or filament. Parts fabricated with TMC are significantly stronger, lighter and considerably more resistant to the stress of extreme temperatures than conventional titanium or super-alloys. They also provide increased performance (range, payload and fuel efficiency).

This technology is key to improvements in propulsion systems for the next generation of commercial and military aircraft. Substantial cost, performance and durability benefits are expected from the use of TMC components in transport and fighter aircraft engines. Other potential applications for TMCs include airframes, medical equipment and chemical processing.

The technology to create items for military and commercial usage using TMCs is not

new. Up to now, unfortunately, TMCs have been cost prohibitive because a production base has not existed to affordably and routinely produce affordable, high quality components. A Title III program objective was to assure that the TMC supplier community is self-sustaining without the need for government subsidy.

The TMCTECC was formed as a precompetitive industry consortium. Original participants included Textron Systems, HOWMET and 3M Industries. As these companies dropped out, they were succeeded by the Atlantic Research Corporation (which has since sold this business to FMW Composites), Pratt &Whitney and General Electric Aircraft Engines (GEAE). In 1996, \$25 million of Title III funds were placed on the existing agreement the Air Force had with the TMCTECC, and the consortium provided matching funds.

Under the Title III project, the TMCTECC aim was to mature the TMC fabrication industry and deploy in advanced gas turbine engines in the form of fan blades, fan frames, actuators, rotors, vanes, cases, ducting, shafts and liners.

A major step in that direction was reducing the cost of manufacturing the nozzle compression link by more than 66 percent. While its competing metal part remains less expensive, continuing cost reduction actions, and improvements in manufacturing processes, will make TMC components more economically attractive for a broader range of military and commercial applications.

With FMW Composites as the supplier, TMCTECC is deploying TMC Nozzle Compression Links into the GEAE F110 engine for the F-16. The compression link deployment over the next eight to 10 years could

mean the manufacture of more than 20,000 parts.

This effort will give the Air Force a viable TMC supplier base for military and commercial applications with affordable TMC product forms through commonality and volume production. Also, the program provides improved engine performance of range,

payload and fuel efficiency in support of the warfighter.

For more information contact the Technology Information Center by calling (937) 255-4689. Refer to item 02-152.



Benefiting from the Title III TMCTECC program, an F-16 fires an AGM-65 Maverick missile during training. (U.S. Air Force Photo)

CoRTM process reduces fabrication and assembly costs

Wright-Patterson AFB, Ohio – The Composites Affordability Initiative (CAI) team has demonstrated a process that will dramatically reduce the costs of composite fabrication and assembly. The CAI team consists of the Air Force Research Laboratory's Materials and Manufacturing and Air Vehicles Directorates, the Navy's Office of Naval Research, Boeing, Lockheed Martin, and Northrop Grumman.

The process they've come up with is called CoRTM (Co-curing of an uncured skin to a Resin Transfer Molded substructure). It was developed by Northrop Grumman, and produces large, integrated, weight-efficient, precise and repeatable structures.

A vertical stabilizer from the F-35 was used to demonstrate the technology. These results, using CoRTM in the manufacturing of the part, revealed that nearly \$14,000 in savings could be derived through reduced tooling, part count, fastener count and the associated fit-up, liquid shimming and surface mold line treatments for air vehicles.

Traditional aircraft structures consist of multiple piece assemblies that are pre-fit together, gaps between mating surfaces are filled with shim materials to create a snug fit, and then mechanically fastened in place. This results in very lengthy manufacturing flow times and high acquisition costs.

Now, the CoRTM process has been proven to be a viable and promising alternative for affordable composite structures. CoRTM combines two cost effective processes: fiber placement (the automated placement of bands of high strength fibers combined with resin onto a tool) for skin structures, currently used on the F-35, F-18, V-22, F/A-22, etc.; and resin transfer molding (the injection of high strength resin into a mold

containing high strength fibers formed to a specified shape) for substructures currently used on the F/A-22 Raptor and a growing list of other aircraft.

Instead of fastening the skin to the substructure, the CoRTM process enables the skin and the substructure to be designed and fabricated as a single component, eliminating the need to fasten them together. This creates structures with fewer parts and minimal fasteners, resulting in reduced assembly costs.

The savings, versus the baseline construction costs, for the F-35 tail represent a 52 percent reduction in part count, a 38 percent reduction in tool count, a seven percent reduction in weight and a 17 percent overall cost reduction when compared to the typical F-35 construction process.

For more information on CoRTM, or the CAI, call the Technology Information Center at (937) 255-4689. Refer to item number 02-068.



Engineers from the Manufacturing Technology Division of the Air Force Research Laboratory are helping develop processes to improve the F-35 while driving cost down. (U.S. Air Force Photo)



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